





# LECTURES

ON THE

## PHYSIOLOGY OF THE SENSES,

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BY

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## P R E F A C E.

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An additional reason urged upon him is the fact, that, in consequence of the inconvenient shape and dimensions of the room where they were orally delivered, much of their substance was lost to many of the audience who honoured the lecturer by their presence.

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## LECTURE I.

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LADIES AND GENTLEMEN,—

It will be my endeavour, in the following lectures, to give you an epitomized description of the phenomena presented to us by a portion of that very interesting series of functions known as the SENSES, OR SENSATIONS, a class not second to any in their importance in the animal economy, and whose physical locality is placed in the great nervous circle.

Inasmuch as the senses of man are necessary to the development of his mental phenomena, they have been very commonly considered as forming a part of his mental essence; and though visibly attached to, and dependent upon, physical organs, they have, in their supposed synonymous nature with the mind, obtained together with it the character of immateriality. This idea, general though it be, is not the less erroneous, and is grounded in ignorance of the laws of our economy. Indeed, we have no right to expect all men to be physiologists; but though they be not so, it is too common



to heap condemnation on those who, having studied the laws of life, refer the senses to the vital actions that go on in the particular organs by which they are represented. There is no cheaper way of obtaining credit for intense morality and devotion than to cry "materialist" against all who speak of mind and sense as connected with matter. Though none can despise this outcry more than myself, I judge it proper in entering on the subject of these lectures to declare, that whilst I am no materialist, I am nevertheless convinced that mind *is* connected with matter, that we cannot study sensation without keeping in view that connexion, and that until we are enabled to judge of mind and sense in their purely metaphysical spirit we can say nothing about them that is rational, unless constant reference be made to the material man, in whom their phenomena are shewn forth.

"I know my existence, because I *feel* it," was the saying of the Greek philosopher. Indeed, the fact is so self-evident, that it is hard to conceive beforehand of the reverse being maintained; which, nevertheless, it has been by a few, both in ancient and modern times. We need not, however, linger to confute this mystical notion of life. "The world of ideas," of the older Pythagoreans, and of the modern Bishop of Cloyne, is a pretty piece of subtilty for quibbling minds that have nothing else to occupy themselves withal: but the appeal to common sense is the best argument against it;



and I have a firm belief that you will be inclined to think so too.

Indeed, the term *life* can only be employed as a collective expression, to signify a certain series of phenomena ; and whether we consider it under the various and incessant changes so constantly succeeding each other on the surface of the earth, constituting the renovation of the atmosphere which we breathe, the purification of the waters which diffuse fertility and health around us, the alternation of day and night, or the motions of the planets and stars, and which may be styled, as proposed by one of our ablest living physiologists, “ *The Life of the World ;*” or whether we regard it in a more limited point of view, as occurring in an individual organized being,—still it is only to be looked upon as one and the same thing. Now as it is my province only to consider life in its more limited range, as it is exhibited in some of man’s functions, it may be well to mention that the phenomena of life are the result of different properties possessed by the different classes of animals and plants. In its most simple form, as presented to us in the lowest tribes of animals, and in all plants, life is evidently the result of impressions on a peculiar principle inherent in themselves, styled *irritability*. The sensible motion displayed by the leaves of the *wood-sorrel*, and the *mimosa*, or *sensitive plant*, by the pistils of the *martinia*, and the stamens of the *prickly pear*, the *pel-*

*litory*, and the *swallow-wort*, are all proofs of the irritability or most simple state of vitality in plants. But in its more complicated form, as exhibited in the higher animals, it is moreover as evidently the result of a still higher attribute, that of sensibility, —a property superadded to the *irritability*, which is the only one possessed by the lowest order of animals, and by plants in general.

In those animals, then, possessed of the most refined degree of organic structure, life is the result of sensation. How commonly do we hear it said that “we have lived a century in a year!” What does this signify, but that the amount of sensation during that brief period has been so great, so varied, so vivid, as to multiply every passing hour, to whirl us through infinite phases of feeling, to make us acquainted with such numerous meanderings of sense as that on looking back upon them we can scarcely credit the existence of so many, in so short a space, and instinctively to compare it to a hundred times its duration? The well recognised fact, that to those who are occupied the time passes rapidly, whilst with the idle it hangs heavily, is amenable to the same explanation. The sensations of a man so occupied follow in such speedy succession that reference to time and space is scarcely at all made: wherefore should he count *minutes*, when his feelings include *hours*? So also of those lofty beings on whom Providence has showered its choicest gift of intellectuality; those

mental meteors who live in light and illumine all around them—the Homers, Platos, and Socrates, of olden, and the Miltons, Shakspeares, and Lockes, of more modern times ; to what do *they* owe their expanse of intellect, if not to the varied and vivid sensations of which their brains were susceptible,—if not to the vast power which the knowledge of such multiplied sensations gave them ? In short, there is no grade of *brute* life, and comparative excellence of *human* life, to which the axiom, that life is at once sensation and the result of sensation, is not applicable. It is the alpha and omega of existence—the thermometer of our being.

But do I speak of sensation as confined to what are known as the five senses of man ? Not at all ; sensation is everywhere, and those are only five specific “sensations” by which man holds more immediate relation with external things. Intended to guide us in establishing relations with matters extraneous to our bodies, sensation includes two defined notions : 1st,—that of ourselves, and the wants involved in our self-preservation : and 2ndly,—that of the external world, with which every animal is inevitably brought into contact, and by which he obtains all that is necessary for his nourishment and subsistence.

Sensation is, indeed, a multiplied function, comprehending a great number of acts, which, for the sake of perspicuity, may be referred to two orders,



—first, *sensations properly so called*, which include all the acts by which the mind perceives impressions made on any organ of the body ; and next, the *moral and intellectual faculties*, which are the operation of the mind itself and the result of the former series of sensations. Into the consideration of the last it is not my purpose to enter in the present lectures ; and of the former I propose to speak first of all generally, previous to addressing myself to the individual and specific sensations.

#### SENSATIONS GENERALLY CONSIDERED.

Although, strictly speaking, intellectual and moral acts are sensations, inasmuch as they consist in perceptions, the term is more usually applied to the different acts by which the mind takes cognizance of the impressions made on any of the corporeal organs. Thus the action by which the mind perceives the impress of a foreign body on the skin, and which is called *touch*, and that by which it feels the want of an empty stomach, and which is denominated *hunger*, are both sensations. In fact, a sensation is the perception of any irritation.

These sensations are very numerous, and, according to the cause of the impression on the organ, are divisible into two series,—the *external* and *internal* ; the former are those wherein the cause of impression is the contact of a foreign

body, as of light to the eye, odours to the nose, &c. ; the latter consist of those in which the cause is organic and internal, as the feelings of hunger, thirst, &c. Both kinds of sensation are safeguards of the economy. The external sensations discover the presence of external bodies with which we are incessantly brought into contact, and whence we take whatever is requisite for the maintenance of life. The internal sensations give us warning of our varied wants, and are the interior sentinels, just as the external are the outermost ones.

Every sensation, whether external or internal, though referred to the organ that immediately recognises the cause of impression, requires for its production the intermedium of the *brain*. It would appear, that the distant part is merely subjected to the impression ; and that sensation is not produced until that impression has been conveyed to the brain, and there elaborated ; in other words, the *impression* is only made on the organ, but the percipient action of the *brain* constitutes the *sensation*. Hence, in viewing a sensation, there are three things to be considered,—the action of the organ to which the impression is referred, that is, *the impression* ; the action of the brain, constituting the *sensation* ; and, lastly, the action of the intervening part or nerve passing between the organ and the brain.

With regard to the first action of *impression*, we may assert, that it is capable for any organ or part

of the body to execute it ; and that each organ owes this capability to the nerves that are distributed to it. It was for a long time thought that certain portions of the body, such as the bones, the sinews, the blood-vessels, &c., were insensible, because pain did not follow the pricking, cutting, or tearing of them ; but numerous experiments and arguments now go to shew that these textures do possess sensibility, though in a lower degree ; whilst in disease they are exquisitely sensitive, demonstrating thereby the existence of nerves in them, as well as in the other textures (the skin, muscles, retina, &c.) to which acute sensibility has never been denied even in health. Sensibility, meantime, and therefore sensation, varies in every individual part, and each requires a certain range of agents to rouse it : what excites the heart will not excite the stomach. Light rouses the sensibility of the retina, but not that of the auditory nerve ; and vice versa.

The next action in the phenomenon of sensation is, *perception*. Every species of evidence goes to shew that this takes place in the brain. The nerves that extend from the impressed part—the foot, for instance—to the brain, are only conductors of the impression. Experiments, in which these conductors have been cut across or stupified by opiates in their passage to the brain, afford ample proof of this ; for below the point so cut across or stupified no agents are capable of mak-



ing any impression. If this experiment be performed on the nerve of the arm at the elbow, all the forearm and hand become insensible to blows, wounds, burns, &c. ; no perception follows, because the conductor of the first impression to the brain is maimed. We need no further proof of this to shew that it is the brain alone that appreciates the operation of causes on the organ first affected, and therefore that it alone is gifted with the faculty of perception.

It may then be asked, whether it is the entire contents of the skull, or only some portion of them, that possesses the faculty alluded to ? Physiological experiments demonstrate that perception resides only in one part of the brain,—a part of it situated at the junction of the back of the head and the nape of the neck ; in other words, at the junction of the brain with the spinal marrow. Indeed, this point is denominated, in anatomical language, the *medulla oblongata*, or the spinal marrow prolonged into the skull. The recapitulation of the immense mass of evidence which has been collected to establish this fact would of itself require more than double the length of time allowed me for the entire discussion of my subject ; suffice it, therefore, for my present purpose, that I inform you, that it has been found that the entire brain may be removed without abolishing perception, provided always that this small point of it be left untouched. And it is, certainly, a curious

corroboration, that at this point all the nerves of sense take their origin. These are discoveries of modern date, which I merely announce; it cannot be expected, as I just now said, that, in a course of this elementary character, I should detail the experimental tests on which they are founded.

Again, it may be asked, in what does perception consist? All that can be answered with certainty is, that it is the result of a *vital organic change* produced in the substance of the brain by the shock of the first impression. This we know must be the case; and with this explanation we must rest satisfied until we are enabled to inspect, with open eyes, the intimate operations of the great centre of perception; a consummation not likely to be attained, however devoutly to be wished for.

The last action to be considered in the sensitive process is, the conducting power of the nerves. Proofs of this power were given incidentally in shewing that the brain alone is the organ of perception. I allude to the cutting across of the nerves that pass between the part first affected and the brain. For the rest, it is too generally admitted that the nerves are the conductors of sensation for me to dwell longer on the point.

But how do they conduct the impression—of pain, for instance—from the finger to the brain? Here, again, we must content ourselves by saying, that an organic change takes place in their substance. Many physiologists, however, have en-

deavoured to erect hypotheses to explain the mechanism of this transmission of impressions. Of these, three only have obtained any credit. The most ancient is, that a nervous fluid or ether passed rapidly from the affected part to the brain, which it roused to perception. Very many of the Arabian, Greek, and Roman physicians held this doctrine, and it even found supporters down to the latter end of the last century. The second hypothesis is, that vibrations take place along the course of the nerves, and produce the same effect in the brain which the supposed fluid was said to do. The third hypothesis is of more recent date, and upholds the existence of an electric fluid which traverses the nerves.

To the *first* of these theories it may be objected, that the nerves are not hollow, and cannot, therefore, contain or convey fluid. I am aware that Professor Ehrenberg has announced, in the "*Transactions of the Berlin Academy for 1834*", but printed in February of last year, that he has ascertained, by the assistance of a compound microscope, that the substance of the brain and nerves does not consist of globular nor of simple fibres, but of tubes, varying in diameter and arrangement, and containing matter of various degrees of density; but these experiments require frequent repetition and confirmation. To the *second*, that they are soft in substance and not tense in their arrangement in the body, and therefore cannot be vehicles



for vibratory movements. And, to the *third*, that there are at most but two kinds of electricity, whereas there are innumerable kinds of sensation in the body.

I have thus endeavoured to lay before you the general idea of a sensation ; and you will perceive that it consists of three actions, and involves three sets of organs :—first, you have the minute extremities of the nervous system acted on by some foreign agent : in the next place, this impression is passed on to the brain by the trunks of the nervous system : and lastly, the brain, urged by the stimulus thus conveyed to it, takes cognizance of the primary impression, and this cognizance constitutes a perception or sensation. It will hence appear, how very far from being passive we are in our sensations. Into all of them, three organs must necessarily enter, and if any one of these organs be wanting in its office, there is no sensation at all. It by no means follows that, because an external stimulating body necessarily affects a sense, simply by its application, as light does the eye, it follows not, I say, that this sense should be passive in the production of sensation ; on the contrary, sensation is the result of its activity ; in proof of which, we may advance, that there is no sensation in death—that during life it varies with the state of health or disease—and that in health it is considerably under the influence of the will, which, as it were, regulates the sense so as to

respond, in the best possible manner, to the exciting agent. When, therefore, we speak of sight as the result of the action of light on the expansion of the optic nerve, we mean, that, as a foreign matter, it excites an action in the retina that is equivalent to an impression; that this action is of such a kind as to be continued along the optic nerve to its termination in the brain, in which, also, an organic action immediately commences, and that action constitutes perception or sensation. The same applies to every other sense of the body, however quickly the sensation may arise. Whether the sound, the light, the odoriferous particle, or the blow, be rapidly or gradually applied to the respective organs of sense, these three processes must of necessity be gone through. It was this astonishing transmission of sensations that first generated the hypothesis of the electric fluid as explanatory of the phenomenon; and it was certainly a much less clumsy agent to press into the service than the liquid and vibrations of antecedent physiologists. The lightning transfer of an impression from the sole of the foot to the brain was not inaptly likened to the passage of the electric fluid from the distant thunder cloud to the attractive earth. In truth, it is a very pretty theory, and there is only one thing to be said against it, namely, that it is not true.

Were we to go further into the subject—into the *results* of sensation excited in the manner

above described, this rapidity of organic action would appear still more astounding. Recognising the brain as the physical requisite for the operations of the mind, and allowing for a moment the localization of the mental phenomena, (which constitutes the science of phrenology,) we suppose the three actions already mentioned to have taken place. What follows? The sensation begets another action in one portion or other of the brain, which action is, *thought*, probably a complex thought, one involving several intellectual, moral, and animal qualities. Thus, the sensation may be *painful*, and the organs of combativeness (or dislike), of self-love (or self-preservation), of destructiveness (to rid oneself of the cause of the sensation), or, on the other hand, of reason and benevolence, which lead one to pity rather than to revenge, may be excited; and this in an instant, almost coetaneously with the primary impression, whether that be an unpleasant object applied to the eye, or a wound of the foot or hand. Suppose a *pleasing* sensation excited by the sight of a beloved object,—by sounds that bring back happy recollections,—or, to pass to less spiritual matters, the taste of some much esteemed dish or drink, we have various actions going on instantaneously in the organs of self-approbation (flattered as we are by possession), of acquisitiveness (anxious as we are to possess what we love), of philo-progenitiveness (if the object be our children), of adhesiveness (if it be our friends);



and these and many more feelings may crowd upon us simultaneously, or in such speedy succession as to defy all the calculations of time and space. Yet let it be remembered, that every thought, however long continued or however transitory, implies an organic action—an action going on in the substance of the brain ; we know not of thought without this ; it is a fact that aids neither materialism nor immaterialism ; or if it did either, it would not be the less a fact.

Viewing the mental processes in this manner, we are bound to consider such individual thought as a separate sensation, and thought in general, therefore, as merely sensation ; a series of thoughts as a series of sensations. And viewing these again as dependent on series of organic actions, how awful is the contemplation of that power and wisdom which could so arrange matter as to allow of the infinitely speedy, yet complex, movements that are essential to the perfection of a sensation or a series of sensations ! Shall we, in dwelling on this stupendous fact, arrogantly declare, that the omnipotence and omniscience of the Creator is compromised by asserting the essentiality of a physical brain for the development of the metaphysical mind ? No ! For, can we picture to ourselves the extent of the power and wisdom that could so contrive that the transitions of *substance* should equal that of *essence* ? No ! that power can have no limit—that wisdom no bounds. In his

material as in his spiritual creations, the infinity of the Almighty attributes remains and must remain the same !

With these notions of the phenomena of sensation in general, we are better prepared to appreciate those of the particular senses or sensations, for the terms are physiologically synonymous.

These are divisible into the *internal* and *external*; I shall first proceed to treat of the internal, as they are the great incentives to the development of the external,—a proposition that will be elucidated hereafter.

#### OF THE INTERNAL SENSES.

The great end of all sensation is to inform us of what is useful, and to warn us from what is hurtful, to our self-preservation. Now, for this end, the external senses,—which make us acquainted with the properties of extraneous things, whose contiguity is inevitable and incessant, and among which we find the necessities of life,—this end of sensation, I say, could not be fulfilled by the external senses alone. In vain would objects of food be presented to the eye, if the internal sensations of the stomach did not lead us to appropriate them ; in vain would the atmosphere play around us, did not the unpleasing sensation of accumulated blood in the lungs induce, nay force, us to inspire it ; in vain would the Oasis and spring rise in the arid desert, did not the sense

of thirst press us to acknowledge these blessings in the gratification of the parched throat. And so of all the internal sensations, to which the external are mere satellites,—servants, who work their masters' bidding,—at once sentinels and foragers, who gratify their wants and guard them from noxious agents.

The internal sensations are numerous, both in brute animals and man. They consist of certain acts of which we have a perception; but they differ from the external senses, inasmuch as the impression producing the perception is not owing to the contact of external things, but is developed in the organ to which the sensation is referred by an organic cause inherent in the economy.

I have compared the external senses to sentinels; they are so, over the exterior of the body; the internal are sentinels within the body, that inform us of its wants. Hence they have themselves been called *wants*, or *animal necessities*. In animal life, nature has left the gratification of these wants to the will of the individual. But inasmuch as it is absolutely necessary for the preservation of species and individuals that they should not be omitted, Providence has most wisely not trusted to the volition of the animal alone, but given them an irresistible character, which, when preservation is at stake, forces him to perform them. These internal sensations of necessity are more numerous in proportion as the complication of the animal



economy is greater ; hence they are most so in the human race.

It is not my purpose, nor, indeed, could I with propriety here enter on the consideration of all these wants and sensations. I shall only speak of a few, and those shall be familiar ones, in exemplification of the characteristics and physiology of the whole.

*First* comes the *sensation of hunger, or the want of aliment*. This is a most powerful sensation, in the brute particularly, whose lot it is not to possess the reason that for a time resists its call. By some it is supposed to consist essentially in an acid fluid in the stomach, which irritates it ; by others, it is attributed to the friction of the sides of the stomach against each other ; and by others, again, to a periodical spasm of that organ. The latter theory is supported by the greatest number of proofs, which it is not my place to enumerate on this occasion. I may merely cursorily remark, that every cause which tends to increase the force of the muscular contractions in other parts of the body, as cold, will as certainly increase the appetite ; while heat, which possesses the opposite power, that of relaxing muscular contractions, will as infallibly diminish the appetite. Opiates and narcotics generally, and pressure, will also remove the sensation of hunger. The Indians of North America travel for days together without food, nor do they suffer from it, provided they have a supply

of tobacco. Sailors alleviate hunger by tying bandages tightly round the stomach, and sometimes increase the pressure by inserting a piece of board, which they cause to press upon the pit of the stomach. Whatever it be essentially, the manner in which it affects the other senses is truly wonderful. To the eye, it gives double acuteness in the search after materials for its gratification; to the sense of smell, it renders the odour of all aliments doubly grateful; the sense of taste is made exquisitely strong, filling the mouth with saliva, and even conjuring up in the imagination the flavour of food; even the sense of hearing is augmented on the subject of aliment, and the common saying, that the "clash of knives and forks is sweet to a hungry man" is founded on strong physiological truth. Over the mind, too, its influence is powerful. When not too acute, and the means of gratification not too far distant, it somewhat impairs the voluntary power resident in the brain, producing unwillingness to movement, and slight tremblings of the limbs. In this case, also, we generally have the evidence of irregular action of the brain in the augmented irritability of temper, and, in very many persons, sleeplessness: to sleep on an empty stomach is, no doubt, a good rule, but it is one which some find impossible to follow. But it is when hunger is so pressing as to endanger the preservation of the individual that its sometimes *awful* influence on the brain and external senses is

perceived. It then maddens the brain, converts the reasoning being into a brute beast : his glistering eyes possess a fearful meaning ; his glazed tongue is hideously projected, as if to seize any thing within his reach ; his senses of smell and hearing are dead to aught but what concerns the frightful sensation within him ; and at length, hunger stimulating the brain to the top of phrenzied desperation, hurling reason from its throne, and converting the man into a demon, has often ended by engendering the horrid cannibalism that renders so truly revolting the histories of too many shipwrecks.

In infancy and childhood the sense of hunger is almost incessant ; the stomach will then digest almost any quantity of food, though not of any varied quality, as in after years. As a general rule, the more complicated the organization of an animal, the more frequent is the return of the sensation in question. Hence, in a man, and more especially in his growing condition, its calls are most rapidly repeated. In him, also, it obtains the most fictitious intensity, it being easy by habit to procure a desire for food every hour even : this of course is a power peculiar to the adult age alone. Disease modifies it in various ways ; most commonly it is diminished in such case. But its very excess forms the essence of some diseased conditions ; in *bulimia*, for instance, it is enormously exaggerated, and to a most revolting extent, and many



such examples are given in the records of medical science. The well-known case of the French soldier, Tarrare, may be cited in illustration. (See Thomas' Practice of Physic.) In *gout*, where there is disease of a portion of the stomach, the appetite is often enormous. In some of its inflammatory conditions, also, the desire for food is frequent and urgent; not unfrequently coming on and disappearing with astonishing rapidity. In vermination, also, it is great, though mostly capricious. Convalescence from feverish disorders is always accompanied with very frequent returns of hunger, which is then so acute as to amount to actual pain and spasm.

The same observations apply to the next internal sensation, which is, the *want of liquids*, or *thirst*. The effects are, however, more speedily developed, and can be resisted for a shorter space of time. Happily, the means of gratifying it are, generally speaking, more readily procured; for anything which excites a flow of saliva calms the agony for a time.

It is a remarkable fact, that this sensation is never at all felt by some persons in a state of health; and many of the lower animals, as parrots, rabbits, and mice, seem, under ordinary circumstances, never to experience it.

In disease, the converse of what was said of hunger holds with regard to this sensation; for it is greatly increased in all disorders where the smallest degree of fever is attendant. Whenever,

also, its return is fictitiously excited, that of hunger diminishes ; the man who drinks much being very rarely a full eater. Thus it is a sign of bad digestive powers when a great quantity of fluid is necessary to enable the individual to take solid food ; dyspeptics invariably drink freely at their meals, whilst those with urgent appetite for food seldom think, or at least take only a small quantity, of liquid at those times.

The *third* internal sensation to which I shall allude is that produced by the *want of air in the lungs*, or the *necessity for respiration*. I will endeavour to give you succinctly an idea how this arises. The blood which arrives from all parts of the body at the lungs has performed its part in the nourishment of that body, is deteriorated, has become of a dark colour, and is unfit to circulate again until it has been exposed to the contact of atmospheric air, by which it is converted into a bright scarlet liquid, highly nourishing, and fit for the support and growth of the body. And how beautifully is this event brought about ! This dark, nay, poisonous, fluid, accumulating in the lungs, begets therein an uneasy sensation,—the internal sense of respiration ; this sensation stimulates the brain, which then puts into action the numerous muscles that expand the chest—and behold the vivifying air rushing down into the lungs to repair the sanguineous fluid that is to assist in the maintenance of all the functions of the economy !

Can man behold such contrivance and not recognise the hand of Omniscience ?

But more than this, no sooner is this internal sensation gratified by *inspiration*, than the brain, no longer stimulated by it, ceases to act upon the muscles that produced it ; these relax, and, with them, the chest ; and the air, which, by contact with the impure blood, has itself become impure, is driven out by the collapsed chest, giving the act of *expiration*. Here, again, we behold simple magnificence of contrivance !

In the ordinary course of life, the sensation of respiration is not attended to, because it is constantly gratified, and never becomes pressing. Its effects on the brain and other senses are not therefore so striking. It is only when impediment is made to its gratification that it is strongly appreciated as an urgent want of the economy. This any of you can certify by attempting to hold your breath. Indeed it is a more urgent sensation than that of hunger. No effort of reason can resist it, as can be done with hunger : there is no time for *longing*, as in thirst ; it cannot be postponed ; it cannot be suspended, without the suspension or annihilation of the individual's life. If impeded in the gratification, the external senses are one by one abolished ; the eye darkens ; the ear is traversed by murmurs, which soon fade ; the touch is no longer excitable ; the tongue lolls tumid and senseless from the mouth : moreover, the blood,



no longer finding passage through the lungs, stagnates in the head and extremities; and the livid face, and blue hands, evidence the dreadful violence that has been done to the organism.

That great physiologist, as well as psychologist, Shakspeare, has thus accurately described the appearances of death by strangulation :—

“ But see, his face is black, and full of blood ;  
His eyeballs, further out than when he lived,  
Staring full ghastly, like a strangled man :  
His hair upreared ; his nostrils stretch'd with struggling ;  
His hands abroad display'd, as one that grasp'd  
And tugged for life, and was by strength subdued.”

*Henry 6th, Second Part, Act 3, Scene 2.*

Yet even in this asphyxysed state, if air be supplied to the lungs,—that is to say, if the strong internal sensation be gratified,—the eye recovers its lustre, and the hopeful hue of health again returns to gladden the sight of the loving and beloved. It is this state that goes by the name of *suspended animation* ; it is not *abolished vitality* unless the gratification of the organic sensation within shall have been postponed beyond a certain period.

All things which violently act upon the mind have the effect of quickening the circulation ; and therefore of causing the respiratory sensation to be more frequently repeated. Excessive love, hatred, fear, anger, and moral anxiety, produce this condition of the circulation ; and we accordingly find these passions accompanied with rapid breath-

ing. That caused by the approach of a much-loved object may perhaps be familiar to many of you, and can need no description of mine. Sometimes this sensation accumulates so much, from various passions, as to render the muscles of the chest incapable of acting with sufficient rapidity to satisfy it. A sense of suffocation or strangulation then seizes the individual, and he may fall breathless and senseless to the ground. Here, too, we see the bountiful provision of nature, for this very suspension of the animation puts a term to the passion that engendered it, and allows the functions to quiet down to their natural state.

Should the sensation not be so excessive, it finds gratification in rapid and forcible inspiration and expiration ; and *sobbing, laughing, and screaming*, are instinctively practised to relieve the oppression within the chest.

On the other hand, any moral feeling that is depressing, and whose tendency is to diminish the rapidity of the circulation, has also the effect of rendering less frequent the return of the respiratory sensation ; of this kind, we may more particularly mention *grief* and *ennui*. In both of these, the brain is deprived of the healthful stimulus by which it would be enabled to afford to the body at large, and to the heart in particular, such genial influence as would keep the functions of the economy in a vivid state of activity. The consequence is, that the heart becomes less sensitive, and ceases to

propel its contents vigorously and rapidly. As a necessary result, blood is less copiously transmitted through the lungs, and their sensations, therefore, are not so frequently presented to the brain. Further, so stupified is the brain in the feelings alluded to, that the respiratory sensation is not attended to until the lungs are gorged with black blood; it then becomes absolutely necessary to change it immediately, and by an effort, and this instinctive effort is nothing else than a *long-drawn sigh*, as in grief—or a *yawn*, as in *ennui*. Every one is acquainted with the relief that this act of sighing brings with it; perhaps this explanation may inform them *why* they are relieved. A sigh is a fertile theme for poets and romancers; but how much do the poetry and romance dwindle when we come to physiological illustration! Alas for the imagination! it follows on the pressing demand of a few ounces of blood to be passed onwards through the lungs; and passed on they will be, in spite of our endeavours to “check the sigh,” or “chill the tear,” that may be its concomitant. So also of a *yawn*, which is generally present when the race of people called *boreds* are near—a race, whose conversation is not only not sufficiently stimulating, but actually depressing, stupifying to the brain. For this reason it is that persons who wish, but are not allowed, to sleep, gape in self-defence. Apt, as *boreds* are, to cause drowsiness, nature has provided a capital hint for them in this



long-drawn respiration ; and well do they deserve the execration of society, if they refuse to understand this *wide-mouthed* appeal to their benevolence, and persist in emanating their narcotic atmosphere.

But when the brain has been anxiously and intently bent upon any one subject, it becomes at length exhausted, and may then cause sighing by the same process as grief does. Thus, love, which, when violent,—that is, in the onset,—I have mentioned as being excitatory of the circulation and respiration, if dwelt upon intensely, and for a long period together, at length becomes oppressive to the brain ; and sighs are then said to express the profundity of the feeling. “ Sighing like furnace, with a woeful ballad made to his mistress’ eyebrow,” is the attribute of the lovelorn swain. He is *obliged* to sigh : but it is much to be feared that the general recognition of the act as an index of the state of the heart and head makes many a youth sigh when he has no occasion to do so. It may be uncharitable to say this, but I have too often seen persons, desirous of being considered in *the* predicament, repeat the action more frequently than nature could possibly require the relief.

Subsequent also upon the greater number of the stimulating passions already mentioned, when reason begins to reassert her dominion, and we look back upon the outrageous state of mind through which we have passed, as on a troubled dream of which we are ashamed, we sigh. We do

so, it is very often said, from a sense of contrition, and we may assuredly be at times contrite ; but whether we be so or not, we are obliged to sigh ; our physical nature demands it for our relief, let our moral being be softened or not. Let us not indiscriminately give credit for repentant feelings to persons who are slaves to the exuberance of passion ; physiology affords us this precept, when conventional metaphysics might lead us to the contrary and erroneous extreme.

It remains only to mention, that *coughing* and *sneezing* are morbid exaggerations of the same internal sensation, or want of respiration. We can resist neither of them beyond a certain period without injury to the organism. Both of them may commence by irritation of the nostrils, as in taking snuff ; but this irritation arouses, sympathetically, the pulmonary sensation, to which we respond *in a loud voice*.

From what has preceded, it will be readily understood that any cause which retards the progress of the black or venous blood to the left heart through the lungs, must augment the frequency of the respiratory want in disease. Accordingly, in all inflammations of those organs, in all their nervous disorders,—croup, hooping-cough, asthma, &c.,—the breathing is augmented in rapidity, and for the same reason diminished in extent ; the greater the quantity of blood to be changed, the greater is the necessity for renewed doses of pure

and purifying atmospheric air. A vast quantity of interesting fact and reasoning might be advanced with regard to the difficulty of breathing that occurs in various diseases, and such a task would be laudable when we consider the excessively coarse ideas that exist, even among medical men, on the subject ; but it would be too obscure and laboured for the object as well as to the readers of these physiological sketches.

So much for examples of the first series of internal, instinctive, or involuntary sensations. As I said before, there are many others of the same character which need not here be entered upon.

We will now proceed to another train of internal sensations.

There are very many functions, the exercise of which is left to our own will, and which we are at liberty, therefore, either to exhaust by excessive use, or leave to dwindle for want of use ; or, lastly, to increase and develop by a due employment of them. With this freedom of use or abuse, how important does it not appear that we should be made acquainted with the precise measure in which we may so exercise our voluntary functions as not to fritter them away, and in order fully and healthfully to develop them ! To guide our volition in this particular, all-seeing and all-beneficent Nature produces in the organs of our voluntary functions *an internal sensation* that gives us warning when they have suffered from excessive use or



excessive inaction. These internal sensations constitute a *second series of wants*, whose number is proportionate to the complication of the animal structure, and the number of voluntary acts of which the individual is capable.

I shall speak of these wants, *first*, as they tend to make us exert faculties that have been inactive ; and, *secondly*, as they tend to make us afford rest to those that have been over exerted.

*There is a necessity for exerting the external senses.* It may indeed be said of these, that the forced obligation there is for the exercise of them in the actual wakeful state never causes us to experience, to *feel*, the internal sensation that would succeed to their prolonged inaction. But we do not require this to prove the reality of their existence ; for inasmuch as all the functions of the body depend on one another, so must the analogy of the other functions lead us to admit the pressing sensation engendered in the external senses. Were a man born deprived of all his external senses, the whole economy would suffer. Can we have better proof that they impart sensations to that economy ?

*There is a necessity for exerting our intellectual faculties.* Here, again, their inevitable presence, when we are awake, may throw doubt on the existence of the sensations they produce. But let us look to our habits, our professional avocations, all imperative as they are to our happiness, and we cannot mistake them for other than sensific



wants. What man, accustomed to an intellectual life, does not feel the necessity for exercising his mind after several days of mental idleness? As a general rule, we may say that *every* faculty ought to be called into use; and when allowed to remain inactive, it begets a want that calls upon us to bring it into play. This rule applies equally to the intellectual faculties with the others of the economy.

*There is a necessity for exciting our moral faculties.* What else is it that forces us to form the bonds of family, of friendship, and of country?—that obliges us to establish our social condition, and guides us in that condition? They are actual wants,—internal sensations,—which, as social animals, we *must* gratify.

*There is a necessity for moving, for entering into some act or other,—in a word, for effort.* Such wants are experienced after a longer or shorter period of immobility, and consist in those indefinable sensations which compel the majority of men to alternate their mental occupations and corporeal exercises.

Reverse sensations to these are those arising from *over exertion of the faculties*. Under this head are ranged the internal sensations of *fatigue*, both of body and mind, which lead us to afford them rest for a period. The *want of repose* is synchronous, if not synonymous, with the sensation of

*lassitude*, and is a real want of our nature. Not less so are the wants of *leisure*, the *necessity of distraction*, and that of *change of occupation*.

Such, then, are the internal sensations of which our British physiologists think by far too slightly ; and the neglect of the study of which leads to such serious errors in the practice of medicine. For only let a physician regard the stomach, bowels, heart, lungs, &c., as mechanical contrivances for the reception and transmission of various extraneous substances, and *not* as highly sensific parts giving and receiving acute sympathies to and from the other portions of the economy,—what is to prevent him from the reckless abuse of his remedial agents on those organs?—what to induce him to substitute mild regimenal means for the eternal and alternate “purging and strengthening” of the digestive organs that is the besetting fashion or besetting ignorance of the day?

Like all the other sensations, they do not depend exclusively on the part to which we refer them. The brain is still concerned in their development ; the impression is still in the part in question ; the perception in the brain, and the transmission from one to the other, is still effected by nerves. Of the cause of the impression, different as it is from, and much more obscure than, that of the external senses, I cannot here speak,—it is a field far too wide for the time I have to tra-

verse it, and far too abstruse for the audience of laics in the science of physiology which I have the honour to address.

I shall, however, terminate the subject of the internal sensations, and of this lecture, by some general remarks on what has been adduced with reference to the former.

A peculiarity exhibited by all these internal sensations or wants is, that they are never indifferent, —never can be passed over. They all possess the type of pleasure or of pain, according as they are resisted or yielded to, moderately or immoderately. Do we not recognise the *pleasure* of gratifying hunger or thirst, and the *pain* of not being able to do so, and the uneasiness consequent on doing so without moderation? This proposition applies to all the sensations in question, and in fact it is by virtue of that alone that they fulfil the end for which they were created,—the end of forcing our volition to acts which tend to the preservation of the economy at large. They first of all impel us to these acts by the attractive power of pleasure ; and if this motive be overlooked by the mind, they impel us by the more imperative voice of pain. The necessities of our nature, however, differ widely in regard of their pressing character, some being more and others less so, according as the consecutive actions are essential to existence. Generally speaking, the physical wants can be least conveniently resisted ; they either overpower



the will, or the conflict extinguishes the individual. Yet both the physical and moral pass through infinite phases of activity or inaction ; and this in proportion as they are opposed or obeyed. At first, each of them diminishes with the readiness exhibited in gratifying it ; but after a time, if we yield too freely to it, an internal sensation, in the inverse ratio, is established. The *necessity* for moving the limbs, for instance, disappears in proportion as we move them, and is replaced by the sensation of fatigue, if this be continued too long. Hunger is diminished by food, too much of which, again, produces the feeling of satiety.

Thus we perceive how much morality is included in the subject of these wants, even the physical. To eat moderately is a *bonâ fide* virtue ; for we thus gratify a want which the Creator has placed in us for the best of purposes ; whilst gluttony is a vice, because we exceed, we overwhelm, the want : we convert into pain what was intended for enjoyment. So also of the moral and intellectual wants. Doubtlessly the intellect was given to us that we should cultivate it, and it is a virtue to do so ; but if we do so excessively, at the expense of the rest of the organism, we are sinning against the laws of our nature,—we commit a crime against our all-bountiful Creator. The brain was made to be worked, but not overworked.

Even our *moral* sensations,—those supremely beautiful parts of our microcosm, those attributes



by means of which we refine the dross of physical existence,—even these cannot be gratified beyond a certain extent without injury to the economy, as well as to the great social family in which we live. Need I multiply examples? May not the necessity for change of mental occupation be converted into the crime of mental dissipation? and it is a fearful crime thus to waste the glorious gift of thought. May not the necessity for rest be degenerated into idleness?

But to proceed. The will which guides, in great measure, the external senses, has no hold on the internal; these we can neither rouse nor abolish at our pleasure. How, in fact, could they have fulfilled their end without this independence? Destined as they are to command the actions which assure our preservation, and to afford us opportunities of enjoying our faculties in all their plenitude, the organs in which they are developed must necessarily be instructed, as it were, beforehand, so as to produce them whenever the conditions where they are essential presented themselves. Still *habit* influences them; and any of the internal sensations may be extended or diminished by comparative attention or indifference to them. Not only does hunger appear at fixed periods, but it increases when too much satisfied, diminishes by the contrary, and is modified by the aliments we are in the habit of taking. An individual who for two or three days takes five meals a day, afterwards finds

it necessary to continue them ; for the sense of hunger returns regularly five times in the same period. Should a powerful exertion of his volition, or some distracting circumstance, cause him to omit two of the meals for a few consecutive days, the sensation fails to return oftener than three times a day, and by further efforts may still be further reduced. But by no effort of volition can we *call up* the sensation ; and in fit time it returns, in spite of the will. It should be no matter of surprise to us, therefore, to behold the huge and frequently returning appetites of aldermen. Neither should the higher feeling of *contempt* be ours at the gormandizing phenomena of Guildhall, and the halls of the corporate bodies, but, on the contrary, that of *pity*, that these splendid specimens of urban dignity should be subjected to the return so constantly of the *devouring* sensation within.

The necessity for sleep, or the sense of somnolence, may, in the same manner, be gradually increased or diminished in frequency, and a man may become a sluggard or an early riser, a glutton or an abstemious man, by habit. It is over this habit that the will has sway, and *not* over the sensation itself.

But most eminently in the *mental* wants is the all-powerful influence of habit demonstrated. Of all our faculties, the intellectual and moral most urgently require exercise and cultivation. Left to themselves, they are far from exhibiting the activity and intenseness which they possess when

cultured by education and use. Hence they exhibit infinite differences in the energy of the internal wants implicated in them. We often hear it remarked, and see it exemplified, too, that if a youth be taken from his tendency he does not do well. The internal sensation which leads a boy to appreciate the beauties of form and colour, if gratified and cultivated, will in time make him a perfect painter. Another's sensation leads him to inquire into the causes of effects ; *he*, by culture of the sensation, becomes a mathematician. A third, with the internal sensation that yearns for the gratification of melodious sounds, does gratify them constantly, and behold an eminent musician ! But attempt to reverse this,—endeavour to force the painter by nature to be a mathematician, or this one to be a musician,—what pain, what misery do you not inflict ? And why ? We force them to resist a natural want within them : we excite a mental conflict, endeavouring to upraise a sensation where nature purposed there should be none, or very little ; in short, we oblige them to sin against their nature : can we be surprised, then, that they often sin against society ?

The intellectual and moral sensations may *all*, however, be cultivated more or less, and in doing so man certainly, upon the whole, adds to the list of his enjoyments ; for all our sensations were given to us for the express purpose of augmenting our happiness. But, as has been already observed, the



super-gratification of any internal sensation is injurious to the economy ; and accordingly, whilst man, in multiplying them by cultivation, adds to his pleasures, he also adds to the chances of his pains. Such is the eternal law of our nature,—such the restrictive ordinance which keeps us within the medium limits of extreme enjoyment and extreme misery.

It has been truly observed by my late lamented friend, Dr. Fletcher, that every creature finds pleasure in the mere exercise of his body, as well as in the repose that follows exertion ; and what is apparent in the body is true of the mind also. It is this delight which we experience in the regular exercise of our functions, both corporeal and mental, which constitutes the love of life and fear of death so universally pervading all descriptions of animals. But this desire of life influences us no longer than we derive pleasure from the exercise of our functions. It is consequently weakened by long disease, or severe mental suffering, and sometimes, unhappily, entirely obliterated. When Socrates inquired of Aristodemus what he thought of this continual love of life, this dread of dissolution, which takes possession of us from the moment we are conscious of existence, his answer was, “ I think of it as the means employed by the same great and wise Artist, deliberately determined to preserve what he has made.”

I have dilated somewhat on these internal sensa-



tions, but not nearly to the extent which the subject admits of. On them are based all the phenomena that constitute our life, and, amongst these, the phenomena vulgarly known as the five senses, and denominated by physiologists, the “ External Senses.” Without the internal, the external senses would not be required. These last it is that do the bidding of the first: the eye seeing, the ear hearing, the nostril smelling, the mouth tasting, and the surface feeling, but to gratify the sensations that arise spontaneously within us, and for our preservation. This is my reason for having entered upon the consideration of the internal senses in the first place. In my next, the external will form the subject of discussion.

## LECTURE II.

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LADIES AND GENTLEMEN,—

Having on a former occasion disposed of the subject of sensation in general, and of the internal sensations, it remains for me, in the present lecture, to exhibit to you the general physiological processes which constitute the External Senses, or sensations. And it may be well at once to state, that it is not my intention to enter at length into the consideration of the agents by which these senses are brought into play. Thus, in speaking of vision, I do not purpose to consider the laws of light ; of hearing, the theory of vibrations and undulations ; of smell, the divisibility of matter ; in short, I do not purpose to treat of the *mechanism* of the external senses, but only of the *vital phenomena* they present, and the influence they exert on our being. For, to be properly treated, the laws of light alone would require much more than the brief space allotted by this Institution, and sanctioned by your patience, for each lecture.

Some leading observations applicable to all the external senses may perhaps render their particular physiological history more intelligible; and I accordingly proceed to make them.

The external senses are organs which, consequently to the contact of divers external agents, produce sensations, by virtue of which the mind acquires notions concerning those agents and their qualities.

Instrumental as they are in arriving at a knowledge of the world without us, they vary in number and delicacy in various animals; for it is by their united power alone that the sum of our information touching the universe is regulated. And, although it has been often attempted to establish the existence of ideas originating independently of these senses, the small number of sectarians of such attempted doctrine, and the necessity for its occasional revival by some enthusiast, from time to time, are strong evidences of the repugnance with which the common sense of mankind has always looked upon this metaphysical dream.

Possessing this office, then, of ascertaining the existence of external bodies, it may be observed, in the *first* place, that the organs of the senses are placed on, or very near to, the external surface of the economy. The organ of *tact* and *touch* is the skin; the organ of *taste* is the membrane that covers the tongue and lines the palate; that of *smell*, the lining membrane of the nostrils; and the



eye and drum of the ear are equally exposed for the purposes of *vision* and *hearing*.

In the *second* place, their situation on the periphery of the body, and their office of putting us in relation with other bodies, render it necessary that they should be symmetrical, that is to say, either exist in pairs, or be formed of two halves. The eyes and ears are instances of the former, while the skin, the tongue, and the nose are of the latter.

In the *third* place, however simple or complex the organs of the senses may be, we always distinguish in them two principal parts,—one a nervous part, situated more deeply, and which, being that whereby the impression ending in sensation is developed, is the most important; and a second part, placed more externally than the former, intended to receive the preliminary contact of the external agent, and therefore arranged so as to suit the physical laws that regulate that agent; the eyes, for instance, being arranged for the refraction of light,—the ears for the atmospheric undulations, &c. Indeed, as on the one hand there are organs of sensation, and as there is no sensation without the existence of a nervous system, the latter necessarily forms a part of them; and on the other hand, as it is essential that the senses should be in immediate contact with extraneous bodies, it is consequently equally essential that a portion of their structure, at least, should be ar-

ranged in accordance with certain physical laws. The perfection, then, of a sense is always proportionate to the structure of these two parts,—the happy or infelicitous development of its nervous apparatus, and the adaptation or inappropriateness of its second apparatus to the wants of the external body that is applied.

In the *fourth* place, inasmuch as the senses are instruments which the mind employs to arrive at a knowledge of bodies, their organs are made dependent for their exercise on the will. Accordingly, to each of the senses a certain apparatus of voluntary muscles is appended, by which we approach them to, or withdraw them from, contact with other bodies. Thus the sense of touch is regulated in its exercise by the muscles of the arm and hand; and to the four others, besides being regulated by the muscles that move the head generally, particular muscles are superadded. Moreover, the will does, in some manner, stimulate the nervous parts of the specific organs, as is shewn by the greater intensity of a sensation whenever especial attention is directed towards it. Do we long for some much-wished-for and expected sound or voice, how acute, and much more precocious, is the auditory sense over those of others not so interested! Does our eye “look out afar” for the hero of our thoughts, or the lady of our love, how much more far-seeing is the vision than when cold indifference renders torpid the thought and the sense! And,

to descend to less spiritual things, how thrice-welcome are the far-away scented viands to the smell, when the stomach yearns to have its sensation gratified ! Have we not heard of the “ tocsin of the soul, the dinner bell ? ” for sweet, indeed, is that sound, when, “ the awful half-hour ” past, it invites to gentle converse over the heaped-up dainties of the table ! Not that the will can arrest the action of the senses when the external excitants are applied to them, for then they are compelled irresistibly to give the sensation of the agents that touch them ; but that the will is capable of withdrawing them from, or exposing them more freely to, the impression of those agents, and thus suspend or exaggerate their office. “ None are so deaf as those who *will not* hear,” is a proverb ; and the much-used process of “ *cutting* ” is an act illustrative of this power of the volition over the senses of hearing and vision. By holding the breath, we can even suspend the sense of taste ; and many do this, we know well, when a nauseous draught is to be swallowed.

As a deduction from this last-named peculiarity, we may affirm that the senses are capable of being exercised in two manners,—either *passively*, when their organs, by the mere fact of their being situated on the periphery of the body, and independently of the will, are acted on by external agents ; or *actively*, when they are moved, and as it were exalted, by the will, and offer themselves



to the impression of those agents. Consequent on the same fact, also, we may conclude that they are susceptible of being educated and rendered more perfect. Education, in fact, means only an improved method of employing our different organs, and therefore can apply only to those of them which are under the influence of the will.

The senses are precisely in that condition. Nothing is more certain than that the proper employment of a voluntary organ is followed by two effects,—namely, to augment its nourishment and development, and to make the movements by which it fulfils its function more easily, more surely, and more rapidly produced. If the organ be not sufficiently exercised, it is neither so well developed in structure or office, and is confined in its action. If, on the contrary, it be too much exerted, it becomes exhausted by the forcible use that has been made of it. Now the happy medium between these extremes constitutes judicious education ; and the senses that are dependent on the will exhibit numerous varieties among men, according as they are obtuse or otherwise, and according as they have been more or less cultivated. The education of the senses, indeed, forms one of the most interesting points of their history, and I shall allude to it briefly in speaking of them individually.

*Lastly*, it may be observed, that whilst the external senses make us acquainted with the qualities

of bodies, we are bound to separate what is due to them alone, from what is referable to the intervention of the mind. There certainly are, in every sense, two sorts of function,—one which is *immediate*, consisting in the physical sensation it affords, which is peculiar to each sense, and which cannot be supplied by any other sense, in the accomplishment of which there is no necessity for the aid of any other one, nor of habit, nor of previous exercise, and which is performed as soon as the organ is properly developed; and another, which is *mediate* or *auxiliary*, consisting in the aid afforded to the mind, and by which the latter acquires its notions of external bodies, and their various qualities. These are multiplex in each sense, are often similar in several of them, and, as regards this peculiar office, the senses may supply the place of each other. Thus light may impinge on the eye, and sound reach the ear, and beget merely the two sensations of vision and hearing; this is the *immediate* office of these two senses; but suppose a certain tune to be heard, it may immediately call up a certain scene which shall pass before the vision, and set the mind revolving in painful or pleasurable reflection. And in this manner one sense may supply the place of all the others; this, in truth, is what is commonly called “the association of ideas.” Through the medium of one sense all the others are put into action, but that portion of the mind called the imagination must intervene

before they can all be aroused. A popular ballad says,—

“ Here’s the bower she loved so much,  
And the tree she planted ;  
Here’s the harp she used to touch,  
Oh, how that touch enchanted !

In this we have an instance of the *mediate* function of the external senses, to which I alluded ; the “ bower and the tree” bring “ the fair, the chaste, the inexpressive she” before the eye of the singing swain ; whilst the sight of the harp brings back to his ear the oft-enchancing canzonet. How beautiful is the science of physiology, when applied to the explanation of our moral sensations ! and how much labour do men bestow on dry metaphysical quiddities, that would be infinitely better spent on the consideration of their mental sensations, as connected with the body that includes the essence of their intellectual and moral feelings.

Let us proceed now to the consideration of the individual external senses. In doing this, I shall adduce the leading facts peculiar to each in its strictly physiological or healthy condition, and then state the modifications that education, age, and, in some instances, disease, produce in it. And first of—

#### THE SENSE OF TOUCH.

This comprises two degrees of sense—namely, *tact* and *touch*, properly so called. *Tact* is, with some few exceptions, generally diffused through all



our organs, but particularly over the skin and linings of the lungs and alimentary canal. It exists in all animals; whilst touch is exerted only by parts that are intended particularly for this use. The latter, too, does not exist in all animals, and would appear to be nothing else than tact united to muscular contraction, directed by the will. In the exercise of *tact*, we may be considered as passive, whereas, we are really active in the exercise of *touch*. Any external body that impinges on our body excites tact; but if we wilfully approach it and handle it, by means of voluntary movements, touch, and not mere tact, is the sensation aroused. By touch, in general, we are enabled to know the properties of bodies, their forms, dimensions, different degrees of consistence, weight, temperature, locomotion, vibration, &c. It is much less subject to deception than the other senses, and enables us to clear up errors into which the others may have led us, and has, in that character, been called their *regulator*. Indeed, from the highest antiquity, touch has been considered of more importance than any of the senses. The hand, being the chief instrument of touch, was emphatically called by Aristotle, the organ of organs—"organum organorum." The idea of its being the cause of human reason has continued down to the present time, and is supported by the eloquent illustrations of Condillac and Buffon. The latter, in particular, gave such importance to it, as to consider

one man possessed of more ability than another only by virtue of the habit of making use of his hands ; and he, therefore, said, it would be well to allow children the free use of their hands from the moment of their birth. This, however, is exaggerating a fact into an improbability: for, as was well observed by Galen, “ it was not because man had a hand that he was wiser than other animals, but because he was wiser than other animals that a hand was given to him, since he alone would know how to use it with advantage.”

The exercise of tact or touch is facilitated by the thinness of the outer skin, by a gentle elevation of temperature, and by an abundant cutaneous perspiration. When the surface is very cold, or thickened by hard labour, or dried by an easterly wind, its acuteness is considerably diminished.

The mechanism of *tact* is extremely simple: the mere contact of bodies with the skin gives us more or less accurate ideas of their tactile properties. The temperature of bodies is the property of which tact is the most capable of judging. In proportion as they approach the point at which they deprive us of our own heat, we call them cold ; when, on the other hand, they yield caloric to us, they are hot. These notions are, however, far from being exactly in relation to the quantity of heat that bodies take or give. We instinctively make a comparison with the temperature of the atmosphere, in such a manner, that a body colder than our

own, but hotter than the atmosphere, appears hot, though it really deprives us of heat when we touch it. Thus, cellars and other subterranean localities, which have an uniform temperature, appear cold in summer and warm in winter, for we compare them with the summer or winter atmosphere which we have just left. A body which is sufficiently hot to cause a chemical decomposition of the surface to which it is applied, produces the sensation of burning; whilst one whose temperature is so low as rapidly to absorb a great portion of the heat of that surface, produces a sensation of nearly the same kind. Frozen spirits of wine, or quicksilver, will demonstrate this. Indeed, there is scarcely any difference between a burn and a chilblain,—the one the result of excess of heat, and the other of cold.

Tact does not exist with equal intensity in every region of the body. Apply the same body to the cheeks, to the back of the hand, the chest, and the foot; the impressions produced will be as various as the localities themselves. This, no doubt, is owing to the greater or smaller distribution of nerves to these respective parts.

Professor Weber has lately published some very interesting experiments, to shew the differences observable in the accuracy of this sense on different surfaces. Where it is acutest, the contact of two points, as of a pair of compasses, is felt to be double when they touch two closely adjoining parts



of the surface. At the tip of the tongue half a line's distance is sufficient, and at the tip of the finger a line. On less sensitive parts the distance must be greater between the points ; on the breast bone, for instance, it requires eighteen lines, and so on.

This sense is very strongly developed in the mucous lining of the mouth, the nose, the eyes, and ears. The drinking of any spirit, the taking of snuff, the action of cold air, and the tickling of a straw, instance these individual susceptibilities. There are some animals in whom tact is more acute than in man ; and they are generally those in whom some of the other senses are deficient. The bat is the most prominent example of this refinement of tact ; for its vision being deficient, it nevertheless continues to fly along a narrow passage without striking against either side of it, and this by virtue of the exquisite tact with which its wings are endowed, and which enables it, as it were, to anticipate the contact of the tactile body.

Tact is subject to modification in the progress of some diseases. In insanity it is considerably diminished, and thus gives lunatics the insensibility to extreme heat and cold, which they are well known to possess. In apoplexy and palsy it is frequently abolished, though not always ; not unfrequently, whilst the movements of the limbs are paralyzed, the sensibility of the skin to contacts is painfully exaggerated. In the early, or shivering, stage of

fever, the tact is totally deranged. We constantly find individuals whose skin is burning hot protest that the whole surface is cold, and that every thing that touches them is also cold, though the room may be highly heated at the time. In many nervous disorders, too, it is morbidly affected: the sensations of creeping, of a blast of cold air passing over a small portion of the body, or, on the contrary, of intense heat over a like space, are instances of this derangement that every nervous person must have experienced at one time or other.

With regard to *Touch*, properly so called, the organ by which it is performed is variously seated in numerous animals.

In very many, the lips, and especially the lower one, are the only organs, and afford a very imperfect degree of touch. The horse, the dog, and the ox, are in this case, as we see when they approach any body whose qualities they desire to ascertain. The comb of some birds, the tentacula of fishes, and the antennæ of insects, as the butterfly, perform the same office for them. The tail of the beaver and the proboscis of the elephant (which is an elongation of the nose) are exquisitely sensitive organs of touch; and it is notorious, that these are two of the most intelligent of the brute creation, so numerous and precise are the notions afforded by this sense. In some animals, the sense of touch would appear to exist strongly over the whole surface; such animals are generally sup-

plied with a thin layer of muscular fibres underneath the skin, which contracts violently when the animal fears the approach of any noxious thing, as is evidenced in the hedgehog and porcupine.

In man, the organ of touch is the hand, and principally the extremities of the fingers, where all the most suitable circumstances are united. The scarf skin is there smooth and flexible, the cutaneous perspiration abundant, the quantity of bloodvessels and nerves enormous, the whole texture of the parts, at the same time, rendering them pulpy and elastic, so as readily to encompass every point of the body that is touched. Withal, the muscles of the arm and hand are exceedingly numerous, small, and of rapid movement, so as to adapt every point of the fingers to the body. We use the whole hand to touch a body of considerable dimensions; but if, on the contrary, it be minute, we employ only the points of the fingers. As long as the hand remains unmoved at the surface of the body, it acts only as an organ of *tact*; to exercise *touch*, it must move either by passing over the surface, to examine forms, dimensions, smoothness, &c., or by pressing it, for the purpose of determining its consistence, elasticity, &c. This, in fact, is the *immediate* function of *touch*. But it is extensively useful in its *mediate* office. Thus, by the medium of the mind, it stimulates and corrects the errors of the other senses. In vain should we endeavour to ascertain the *temperature* and *consistence* of bodies



by the eye or the ear : persons do, and things may, *look* warm, but touch alone can make us certain of it. So also of the forms and dimensions of external things, in judging of which the sight is assuredly *generally* useful, but by no means is it so precise as the touch. Is there a doubt on either of these points, we instinctively bring the organ of touch into play to certify to the other senses what they could not alone determine ; this is why it has been called the *geometrical* sense. In this character, it might go far towards settling the endless disputes in the science of perspective, provided it were the interest of the disputants to appeal to a certain and common sense rather than to their own vision, deluded as it is by preconceived and obstinately retained opinions. It is curious constantly to find our most vulgar sayings founded on some physiological fact, the rationale of which is mostly but little known. “Seeing is believing” is one of such ; that is, we believe a body to be what we see it ; but we acknowledge the possible fallacy of this belief by adding, “but feeling is the truth itself”—confessing, that by the touch alone we can discover the actual state of the case.

Like most of the external senses, touch is considerably augmented by the absence or obliteration of any of its fellow sensations. And as it is more especially adapted to correct the errors of vision, so when the latter is wanting the former is ren-

dered more exquisite, and has been even known to supply almost its place. The instances of refined touch in blind persons are familiar to every one. The sculptor Gannasius, after becoming blind, continued nevertheless to practise his art by his increased sense of touch. Gumbassius Vodateranus, a sculptor of Rome in 1636, made effigies of many of the great men of his day, working equally well in a dark as a light room; and Saunderson, the antiquary, though blind, could tell by his fingers a genuine from a spurious coin; indeed, it is only necessary to visit our numerous asylums for the blind, to find ample proof, in the beautiful and delicate manufactures there produced, of the bounty and beneficence of our Creator in providing for the absence of one sense by the increased capabilities of another.

The changes wrought by age and other circumstances on this sense are considerable: in infancy, tact is very acute; the cry of a new born infant is owing to the excessive pain produced by the contact of the atmospheric air. Touch, however, being an active sense, is not so acute in infancy. It requires education, and, as that is obtained, children cease to handle things in the awkward manner we observe them to do in their earliest days. In the course of life it may be rendered astonishingly refined by the exercise of various professions. Printers, engravers, and watch-makers, educate it thoroughly in their respective avocations, con-

stantly handling, as they are, minute bodies. A skilful printer is able to distinguish the small type called *diamond* with a rapidity and precision that is almost incredible.

Both tact and touch lose much of their delicacy in the lapse of years ; they become sensibly impaired in the aged : for, besides the blunted perception inevitable in them, the skin also undergoes an unfavourable change ; the outer skin is no longer so flexible, and becomes dry from stoppage of the perspiration of the hands ; the fat, too, which formerly sustained the nerves, having disappeared, the organ becomes wrinkled and flaccid. We constantly behold aged persons pausing over objects they handle,—a sheet of paper, a pen, a pin, &c.,—and passing them repeatedly through the fingers, before they make up their minds as to their qualities.

In disease, the touch is generally exaggerated. In convalescence from the majority of fevers, it is considerably excited ; and in scarlet fever, in particular, it frequently acquires a painful degree of sensitiveness. In hysterical disorders it is often most curiously deranged—females so afflicted having been known obstinately to assert the existence of tumours in various parts of the body, and trace them out with the fingers, when to every body else there was not the slightest appearance of such. So much on the sense of tact or touch. Let us next consider—



## THE SENSE OF TASTE.

By this we obtain a notion of that quality of bodies called *sapidity*. It is in analysis a variety of touch ; more delicate, however, better adapted for ascertaining the most intimate characteristics of bodies, and confined to a smaller portion of the economy, the roof of the mouth and the upper surface of the tongue being its locality.

The word *savour* is employed to express the particular sensation caused by *sapid* bodies on the organ of taste. It is also used, and more commonly, to designate the agent which is the cause of *sapidity* in bodies. In this latter acceptation, *savour* is the integrant molecule of the *sapid* agent, for it is this molecule that acts upon the organ of taste, and produces the impression in which the sensation is founded. There is, however, nothing elementary or specific in the *savour* of bodies ; it merely implies those atoms of them that cause sensation ; were it otherwise, there must necessarily be as many *sapid* principles as there are *savours*, which is not the case. Besides which, the same *sapid* body produces different sensations in different individuals, which could not be the case were it elementary, specific, and unchangeable.

On the arrangement of the atoms of bodies, therefore, or, in other words, on their chemical nature, the *savour* of bodies depends. Now the

atoms of some bodies are so arranged as to be soluble, others insoluble. It is the former only that are capable of generating taste, and it is necessary that they should be soluble in the saliva at its ordinary temperature; insolubility and insipidity, on the other hand, always go together.

Savours or tastes are very numerous. They are as diverse as the sapid bodies themselves, and they vary with the organ of taste itself, as it is found in different animals and in different individuals of the same species. Many attempts have been made to classify tastes. Galen made eight kinds,—the *austere*, the *acerb*, the *bitter*, the *salt*, the *acid*, the *acid*, the *sweet*, and the *fatty*; Haller eleven,—*mawkish*, *sweet*, *bitter*, *acid*, *acerb*, *acid*, *saline*, *spirituous*, *aromatic*, *nauseous*, and *putrid*. Linnæus arranged them into opposites,—as, *mild* and *acid*, *fatty* and *styptic*, *viscid* and *saline*, *moist* and *dry*, &c. All such attempts, however, must necessarily be imperfect, for nothing is easier than to create a name for every shade of the same taste, and thus to augment *ad infinitum* the number of savours.

The only natural division of tastes is, into the *agreeable* and *disagreeable*. Even with this, we are obliged to confess our ignorance wherefore a taste is agreeable or otherwise, and to allow that this connexion between agreeable and disagreeable is only to be understood as of one determinate animal species, frequently only a single individual of it, and even of *him* only when he is in a certain

condition of body. This proposition scarcely requires particular illustration, as regards the tastes of different species ; so numerous are the examples that will occur to any one present. Between individuals of the same species, also, the sense differs materially — a physiological fact so universally acknowledged as to be expressed in most European languages by varied proverbs : “ What’s one man’s meat is another’s poison,” and such like. But taste varies likewise in the same individual at various times. We all know how much of what is called the “sweet tooth” prevails in youth, and how it gives place to the preference for savoury animalized substances in middle age. Savours which in health are detestable, frequently are desired when sickness invades, and vice versâ. Of the efficient cause of these peculiarities, all we can affirm, and all that we shall probably ever be able to affirm, is, that they depend on the varied arrangement of the nerves of the tongue and the changing perceptive faculty of the brain. Neither is it in our power to define any of the numerous tastes we experience. Every sensation cannot be expressed by language ; all we can do is to recal it to those who may have felt it ; if it has not been experienced, nothing we can *say* will give them an idea of it. In the same manner that it is impossible to give a person blind from birth an idea of colours, so is it equally impracticable to convey a notion of taste in general,



or of each kind of savour in particular. Hence it is that, being unable to taste with the tongue of another individual, there may be hundreds of tastes perceived by others which to ourselves are totally unknown. Hence, too, the futility of attempting any natural or artificial division of savours, even, as I before said, into agreeable and disagreeable. By a wise provision, meantime, it has been ordained, that those things which are generally useful for nutrition are agreeable to the taste, whilst those whose savour is disagreeable are for the most part hurtful.

I have said that the roof of the mouth, and the upper surface of the tongue, are the organs which minister to the sense of taste. Neither of these parts, however, *separately*, can so minister. A sapid body applied to the surface of the tongue alone excites no taste; if it be excessively acrid,—if it be, for instance, a very strong acid,—it will cause *pain* when so applied, but there will be no acid taste. The same may be said of the roof of the mouth. In order to the development of the sensation, it is necessary that the sapid substance be more or less compressed between those parts after its solution in the saliva. Moreover, for the full exercise of taste, the mucous membrane investing the organs of it must be perfectly uninjured; it must be covered with mucous fluid, and the saliva must flow freely into the mouth. When the mouth becomes dry, the powers of taste cannot be excited. It is also neces-

sary that these liquids undergo no change ; for if the mucus become thick and yellow, and the saliva acid or bitter, the taste will be excited but very imperfectly. Some substances, as vinegar, the mineral acids, and various salts, seem to produce a chemical as well as a vital effect on the membrane that lines the mouth, the latter taking on a white or yellow hue. The same effects are similarly produced in dead bodies ; and we have hence some ground for supposing that to this combined chemical and vital action the different kinds of impressions made by sapid bodies, as well as the variable durations of those impressions, are attributable.

Some bodies leave their taste for a long time in the mouth. This is more particularly the case with aromatic substances,—as cloves, cinnamon, &c. This kind of after-taste is sometimes felt in the whole mouth, at others only in one portion of it. Thus, bitter substances leave an impression at the back part of the throat ; acids, upon the lips and teeth ; and peppermint leaves an impression that exists both in the mouth and throat. With regard to this action of acids on the teeth much obscurity prevails : it is not by a merely chemical action that these set the teeth *on edge*, for the sight, or even the recollection of a sour taste, will produce the feeling. The teeth are said to possess the power of absorbing fluids, and the phenomenon alluded to has been attributed to that power ; but, for the

reason just stated, this explanation is unsatisfactory. Tastes, to be completely known, ought to remain some time in the mouth; hence, wine-tasters retain the wine for a long period in the mouth, and afterwards iterate it again and again by smacking their lips—or, in other words, the tongue and palate—together, after they have ejected the fluid. The same is done, instinctively, when hunger is pressing, and the smell of food invades the nose, or the idea of it fills the imagination; it is a kind of preparation for the gustatory pleasure,—a sort of training of the sense, so as to render it capable of the full fruition, when the sapid aliment is applied to it. For the same reason we allow those bodies that have an agreeable savour to remain a long time in the mouth; and, for the contrary reason, we swallow as quickly as possible those which are disagreeable, at the same time holding the breath so as not to smell it. Indeed, the connexion between taste and smell is of the closest kind: the combination of the two in the appreciation of aliment is called *flavour*; and we generally find that, when one of them is obliterated temporarily, the other is also diminished or suspended.

When we taste a body that has a very strong and pertinacious savour, such as vegetable acids, we become insensible to others that are feeble; and this fact might be very usefully applied in the administration of nauseous drugs.



In childhood, the taste is exquisitely perfect as regards intensity ; but the capability of appreciating a number of different tastes at once is not so great at that time. This is the result of the education of the sense ; and some men, as wine-tasters and chemists, acquire a wonderful nicety in this particular. Every one has heard the tale of the wine merchant who detected the tastes of leather and iron in a pipe of wine, which was subsequently found to contain a key tied to a leather thong. By taste, too, chemists obtain a tolerably precise notion of the chemical combinations of substances ; they can often discover the ingredients of a complicated medicinal mixture by the delicacy acquired by long practice.

The choice of food depends on taste, which, joined to smell, enables us to distinguish between substances that are hurtful and those that are useful.

Taste continues to extreme old age, becoming, however, gradually weakened. Hence, old people generally require food and drink that have a strong savour ; but this is in unison with the wants of the organization, to which active excitants are necessary for the preservation of its expiring powers. In hot climates, too, where the waste of the vitality of the body is continual and great, the taste also yearns for stimulating substances ; and the East Indian curry, and the West Indian “ pepper-pot,” are essential both to rousing the sense

of taste and enabling the ingestion and digestion of food. The morning after intoxication is likewise a period of organic exhaustion; and persons, accordingly, find stimulants of cayenne, of sundry "devils," or "a hair of the dog that bit them," essential to "winding up" the system.

The taste is depraved in all diseases accompanied with fever. There is a bitter taste with irritated liver; a sour, mawkish, or metallic taste with irritated stomach, with indigestion in fact; and spitting of blood from the lungs is always preceded by a salt taste in the mouth. In nervous complaints, all manner of tastes come and go in endless succession: a taste of blood is very commonly complained of by hypochondriacal patients, as is also a putrid taste. It is more or less abolished in palsy, and in common cold in the head. On the other hand, it is morbidly excitable in some stages of pulmonary consumption, and in convalescence from all febrile diseases, when the stomach is frequently craving for food to repair the inroads made by disease. In fact, there is a constant parallel of the taste with the internal sensation of hunger.

#### SENSE OF SMELL.

This is also a species of touch, but of a still more delicate character than taste. By it we appreciate that quality of bodies which has the name of *odour*. Odour bears the same reference to the nostrils and olfactory organs that savour does to the tongue

and palate,—that is to say, it consists in the direct application to the expansion of the nerves of smell of the particles or molecules of the odoriferous body from which they arise. The chief difference between smell and the two other senses of touch and taste is, that in the former the substance that possesses the odour acts at a considerable distance, whereas in the latter the exciting agent must be in immediate contact. A German physiologist (Walther) has advanced an opinion, that bodies are only odoriferous by virtue of a vibratory movement analogous to that effected by a sonorous body. But when we see odours confined in glass vessels; when we see them suspended in aqueous, oily, or alcoholic fluids, to which they transmit their properties, and for each of which particular odours have a particular affinity; when, lastly, we observe odours act on the economy at large, through the medium of the sense of smell, there can be no doubt that they are specific particles of matter, and not modifications of the movements of matter. Besides, this has been proved experimentally. The French chemists, Berthollet and Prevost, placed a piece of camphor at the top of a tube filled with mercury, and found that, after some time, the mercury had fallen, and its place was occupied by an odoriferous gas.

The cause of the emanation of odoriferous particles from bodies is generally supposed to be owing to their volatilization by heat. Remark, however, that heat does not *make* those particles, it only



facilitates their evolution into the circumambient medium. Whatever the cause be, it is certain that odours form around each odoriferous body a peculiar atmosphere, which is more dense the nearer it is to the body itself. From this last they are projected in all directions ; and, as may be easily conceived, the more they are condensed the stronger is their influence on the olfactory organs. Being evolved, they spread abroad in the atmosphere, in which they are as it were dissolved, and the impulses and directions of which they follow. As a general rule, when the atmosphere is tranquil, the force of odours is in the inverse ratio to the squares of their distances. Still there is much diversity in the distances to which they are capable of extending ; mostly, those distances are considerable. A single grain of musk may be smelt through a very large room. It is said that vultures travelled from Asia to the battle-field of Pharsalia, attracted by the smell of the slain. It is a well-known fact, that the white bears come swimming round the Greenland ships, when a whale is cutting up, from all quarters, and far out of sight. And Boyle mentions, that some sailors of his day knew they were approaching the island of Ceylon when at a distance of nearly thirty miles, by the scent of cinnamon that wafted over the vessel. Some odours, however, are far less soluble in the air ; roses, for instance, concentrate their smell in the bush on which they grow ; jasmine, clematis, and some

other creepers, propagate theirs to a long distance. The tenuity of odoriferous particles must be inconceivable ; for a body may continue to give them out for a long time together, and yet lose no weight in a sensible degree. Boyle and Nollet calculated that two grains of musk are divisible into 22,658,584,000 molecules. Odours are constantly cited in illustration of the extreme divisibility of matter. It is very probable that air is the only vehicle of odours ; hence, the sense of smell has been denied to aquatic animals, and especially fishes. But it must be remembered, that there is always some air mixed with water, which may convey the odorous particles to the sensific organ of fishes. Moreover, it is well known that they are attracted from some distance by the scent of various baits ; and they have a well-developed olfactory nerve. Odours may, however, be produced *in vacuo*. The whole subject of the transmission of odoriferous particles requires further investigation. By what means, and wherefore, do odorous particles make an impression on the olfactory organ ? Some say it is owing to their shape : but who can ever see this ? Others think that it is attributable to their chemical nature ; but they cannot specify what composition makes them so, nor can they analyse them ; otherwise, it were easy to tell beforehand the smell of any thing. The fact is, we know nothing about the matter ; the nose alone appre-

ciates odours, and no manipulation can discover them to the other senses.

It has been attempted to divide odours into *animal*, *vegetable*, and *mineral*. But this will not stand ; for the smell of musk, for instance, is exhaled from the crocodile's skin, the musk rat, and from some of the human race ; it is given out by some vegetables,—the musk plant, and the musk rose ; and from some of the salts of gold, and a peculiar earth of which they make tea-cups in China. The odour of garlic, too, is exhaled from the plant of that name, and from the metal arsenic ; and many other examples might be given. Haller divided them into the *ambrosiac*, or agreeable ; the *fetid*, or disagreeable ; and the *mixed*. Linnæus had seven kinds—the *aromatic*, as in the violet ; the *fragrant*, as the lily ; the *ambrosiac*, as musk and amber ; the *alliaceous*, or garlic ; the *fetid*, as in the ram ; the *venemous*, as in most narcotic plants ; and the *nauseous* ; but he forgot mineral smells altogether. Lorry speaks of the *camphorated*, *narcotic*, *ethereous*, *volatile*, and *alkaline* ; and Fourcroy, of the *extractive* or *mucous*, the *fixed oleaginous*, the *volatile oleaginous*, the *aromatic*, the *acid*, and the *sulphureous*. The only division, however, that is at all tenable, is into the *agreeable* and *disagreeable* ; and, in adopting this, the considerations enumerated in the same division as regarded tastes are always to be kept in view. Agreeable and disagreeable are purely relative terms.



The organs of smell are made up of the olfactory nerve spread over the lining of the nostrils, and that of a sinus, or furrow, that runs between the two plates of bone forming the forehead. According to the size of the bones that form the nostrils is the delicacy of the sense. All animals with large noses, therefore, have it acutely,—such as the sheep, the pig, the pointer dog, the vulture, the elephant, and all bipeds in whom this feature is largely developed. It is calculated, that the investing membrane of each nostril in the seal presents a surface of 120 square inches. In the sheep and dog the olfactory nerve is very large indeed. No less than fourteen bones enter into the organ of smell in man.

With regard to the process of smelling, it may be observed, that inspiration is essential to its enactment ; the air charged with the odorous particles being necessitated to pass through the nostrils and impinge on the sensitive lining membrane. Perrault and Lower found, that when the upper part of the windpipe of dogs was opened, and the respiration continued by it independently of the nostrils, the animals lost all their smell, for they then willingly took food which they had previously refused. Besides, we all know that the most approved mode of escaping a disagreeable smell is to suspend respiration ; or taking the opposite extreme, do we not, when desirous of having the full scent of a perfume, bring it close to the nose and inspire

strongly? We thus see how well it is contrived that the sense in question is situated in the passage to the lungs; a contrivance that also aids another bountiful end; for it gives us the opportunity of analysing the air before we inspire it. Indeed, the sense of smell would appear to be to the lungs what that of taste is to the stomach,—the sentinel against the entrance of noxious matters.

It cannot, however, be denied, that odoriferous particles impinge on the nostrils, spite of the respiration, and by virtue of their expansibility alone. Thus it frequently happens, that suspension of respiration is not sufficient to prevent their ingress, but we must also mechanically stop the nose by compressing the nostrils. There is also a beautiful law of nature, with reference to the impression of bad odours, which is, that they highly stimulate the nasal membrane, and cause it to secrete a larger quantity of fluid than usual; and this excess of fluid goes to protect the nerve of sense from further impression. It is a common belief that medical men are better authorized than others to take snuff, on account of the bad atmospheres they are occasionally forced to inhale; what has been just stated corroborates the justice of the exception made in our favour.

Of the intimate change in the nerve caused by the scented particles, we know nothing, and probably never shall. The impression is conveyed to the brain, and it does what seems fit to itself. The

influence of odours thus introduced is undoubtedly great over the whole system. Every one knows that disgusting smells produce fainting and sickness of stomach ; while agreeable ones cause fainting and other fits. The modern Roman ladies are constantly instanced as examples of the latter ; they eschew all perfumes, and if the *attar-gul* be presented to their nostrils, straightway—

“ Die of a rose, in aromatic pain.”

Most animals are violently affected by peculiar odours ; *valerian*, for instance, drives cats into a state approaching madness. In some cases it would appear as if the odoriferous particles were absorbed and carried into the system. It is related that Democritus lived three whole days on the vapour arising from new bread. Lord Bacon cites the case of a man who could support an abstinence of several days by inhaling the odour of aromatic herbs and garlic, mixed. Boyle gives an instance where two persons were violently affected in the bowels by scraping black hellebore root and colocynth. The same frequently follows the pounding of jalap and aloes, by those not yet accustomed to drugs. Pounding or rubbing ipecacuana will often produce sickness. Hanging over opiates will soon stupify to sleep ; and pouring spirits from one vessel to another will, sooner or latter, according to length of habit, inebriate by the constant inspiration of their vapour.



Smell is but feebly developed in infancy, few infants being at all cognizant of the odour of the food or physic presented to them; they judge by other senses, the taste especially. Smell goes on increasing in intensity through life, and is perhaps stronger in old age than at any other time. It continues to the last moment of existence: hearing, sight, touch, and taste, are blunted by extreme longevity, but this is seldom or never the case with the smell.

By disease it is variously modified. It is suspended in all complaints that impede the passage of the nostrils,—cold in the head, long-continued snuff-taking, &c.; for this last habit *does* establish permanent disease of the nostrils. In asthmatic persons it is strongly developed, the forcible inspirations they make applying odours with vehemence to the nerve of sense. It is obliterated in general palsy, and perverted in a thousand ways in nervous disorders, where it is the subject of endless imaginations.

#### SENSE OF HEARING.

The intention of hearing is to make known to us the *sounds*, or *vibratory motions*, of bodies. The external excitant in this sense, therefore, is not the sonorous body itself, as is the case in touch; neither is it the integrant molecules, as in taste and smell; it is simply the repetition by the air of the vibratory movements of the body.

Sound, then, is the result of an impression produced upon the ear by the vibratory motion excited in the atoms of the sonorous body by percussion, or any other cause. It also means the vibratory movement itself. The atoms of a body having thus been put in motion, they communicate it to the surrounding elastic bodies, these communicate it in the same manner, and thus the vibratory motion is continued onwards to a great distance. In general, elastic bodies are alone capable of producing and propagating sound ; but, for the most part, solid bodies *produce* it, and the air is generally the medium by which it reaches the ear.

The strength or loudness of a sound depends on the *extent* of the oscillations ; that is to say, the sound is loud if the oscillations are extensive, and feeble in the contrary case. Thus, in striking a tense cord we find the sound diminish in proportion as the amplitude of the vibrations diminishes. This is the reason why the cords of string instruments intended to produce bass notes, are more loosely stretched than the treble strings.

The *tone* of sounds depends on the rapidity of the oscillations—on the number of them in a given time, without reference to their extent. We have a bass or grave tone if the vibrations be slow, and a treble or acute one if they are rapid. And as there are numberless degrees between the loudest and weakest sounds, so are there between the deepest and most acute. The deepest

sound the human ear can distinctly appreciate is the result of thirty-two vibrations in a second ; and the most acute, of between ten and eleven thousand in the same time. The recent investigations of Savart, however, shew that acute sounds may be perceived resulting from twenty-four thousand impulses, and grave ones from seven or eight impulses only in the second. All appreciable sounds are between these two extremes, and all beyond and below them is nothing but *noise*. In fact, the difference between sound and noise is, that in the former the undulations are permanent, regular, and such as the ear can appreciate, whilst in the latter the ear cannot appreciate them, either because they are not permanent and regular, or because noise consists of a confused multitude of sounds, possessed of no precision.

The *expression* of sounds is generally supposed to depend on the substantive nature of the sonorous body, if this be a surface, and likewise on its form, if it be a hollow cavity. The French physical philosopher, Biot, conjectures that it is owing to the series of *harmonic sounds* that accompany any appreciable sound. If we strike a sonorous body, there is a clear distinct sound ; but a little attention shews us that there are other sounds attendant on it ; these are the *harmonic sounds*.

Sound is propagated through all elastic bodies. Its rapidity, which varies, however, with the body that propagates it, is, in the air, 1130 feet in a



second. The denser the medium, the more rapid the progress ; hence water transmits it more rapidly than air, and a condensed frosty atmosphere, than a warm light one. A pistol fired at the summit of Mont Blanc by Saussure, gave scarcely more sound than a pop-gun. In a vacuum, there is no sound at all. Again, it loses its force in a direct proportion to the square of the distance, when propagated in the air. It sometimes becomes more intense as it proceeds ; this is the case when it passes through very elastic bodies, such as metals, woods, condensed air, &c.

All elastic membranes, whether dry or humid, vibrate, and transmit sound, if sonorous vibrations are made perceptible near them, and without their being in unison with the bodies that produce the vibrations. The degrees of tension, of thickness, and humidity of the membranes, influence the facility of the production of vibrations ; but whatever may be their state, they always vibrate in unison with the sound produced. On this law much of the faculty of recognising sounds possessed by the ear depends, for that organ is, in great measure, made up of membranous elastic parts.

When sound meets a body that stops its passage, it is reflected ; the angle of reflection being equal to the angle of incidence. The form of the body that reflects sound has a similar influence upon it. The slowness with which sound is propagated produces

certain phenomena, for which we can easily account,—for instance, the *echo*, the *mysterious chamber*, the *whispering gallery*, and others.

The anatomy of the organ of hearing is much too complex for minute description on the present occasion. Suffice it to state that it consists of the outer ear, which is so formed as to concentrate sound, and which dwindles into the outer passage of the ear ; at the end of this passage, and across its whole calibre, a membrane called the drum of the ear is stretched. Fixed to the centre of the inner surface of this drum is a small bone, which communicates by minute joints with three others, placed *seriatim* like a chain. The last or innermost bone is, like the first or outermost one, fixed to a small membrane, which stops the entrance to certain convoluted semicircular canals. These canals, which are scooped out of solid bone, contain the soft pulpy nerve of hearing, floating in a transparent fluid, named, from its discoverer, the *fluid of Cotugno*. Beside this, there are two tubes—one on each side—that proceed from the back part of the mouth and nostrils into the small cavity in which the minute bones alluded to are placed ; these are for the purpose of introducing air inside as well as outside the drum, so that the vibrations may be continued.

The mechanism of hearing, then, is simply this : vibrations are excited in the external atmosphere, which at length strike against the drum of the ear ;

it is shaken by them, and in its turn shakes the small chain-formed bones; these again produce vibrations in the membrane that stops the semi-circular canals, and the vibrations ultimately cause commotions in the fluid of Cotugno and the auditory nerve floating in it. The result is hearing. The bones spoken of are, however, provided with excessively minute muscles, that are under the dominion of the will, as is also the outer ear, though in man they are merely rudimentary. Use, however, will develop them exceedingly, even in man, as is seen among savages, who frequently have the power of raising and contracting the ear so as to concentrate sound. The essential part of the organ though is, the soft nerve floating in the transparent fluid, for there are instances in which all the other portions of the ear have been wanting, yet the sense continued. On the other hand, if the nerve be palsied, or the fluid of Cotugno be dried up, there is no hearing.

The immediate use of hearing is to recognise sound. Its mediate uses are more multiplied than those of taste and smell, and, after touch and sight, it has been said to aid the intellect more than any. We will consider two points of intellect of which it has been said to be the foundation,—namely, *music* and *spoken language*. Most metaphysicians, indeed, have attributed these faculties to hearing alone; but Gall has triumphantly shewn the fallacy of this.



If the faculty of combining sounds in harmonious accord, so as to constitute music, really depended on hearing alone, it would exist in man and animals in a ratio with the structure of the ear. This, however, is not the case. Very many animals have a finer ear than man, yet none are so musical. There is no connexion between the power and character of their music, and the perfection of hearing. Birds, for instance, that do not sing at all, have as finely formed an ear as those that do ; the male, too, is generally the only singer, yet his ear is the same as the females. Many of them, too, only sing at the period of mating. Again, each bird obtains and preserves the song of his own species in the midst of other birds, and even without hearing that of his parent. The cuckoo, which is invariably reared by others than his parents, nevertheless, sings as the latter did before him. Even in man there is no connexion between the musical nicety and the delicacy of hearing. The best musicians have by no means the best constructed ears, nor the most acute sense of hearing. Persons becoming deaf preserve their musical taste, and go on composing, sometimes more exquisitely than ever ; this was the case with Beethoven. Even deaf and dumb people from birth have been known to possess considerable musical talent. Idiots, who cannot learn a single tune, have nevertheless a perfect organ and sense of hearing. In short, numberless facts conspire to prove that the

musical ear, as it is called, is not dependent on audition, but is a higher, an intellectual faculty, in the accomplishment of which the ear is only a necessary secondary instrument.

So also of *artificial spoken language*. If animals have it not, why is their ear as finely, and, in many instances, more finely formed than man's? If, on the contrary, they have it, how comes it that, with an ear as nearly as possible the same in all, their languages are so different? Why has each species only its own? Looking to our own race, let us ask whether poets and orators have necessarily the most delicate hearing? How many idiots have it in perfection, yet never attain intelligible speech? The fact is, that spoken language is an intellectual faculty, towards which hearing is only an instrument,—essential, it is true, but still only secondary, and intended to transmit to the brain the sounds to which the latter alone has attached ideas. Languages are so much the creation of the mind, that in all people and individuals they are relative to the number and character of ideas and sentiments. Civilized nations speak languages that are rich, in comparison with those of barbarians. Individuals whose thoughts are numerous and energetic, and whose feelings are quick, have both grandeur of language and vivacity of expression, and vice versâ. In both instances, the ideas, and not the hearing, are the starting point of the speaking faculty.

I need scarcely mention how capable this sense is of cultivation. In the precariousness of savage life, it becomes exquisitely delicate by the forced education of necessity. Blind persons also cultivate it from necessity; and we generally find them, as it were, “all ears.” It may be exercised either actively or passively,—the latter, when we *hear*; the former, when we *listen*. Some few brute animals are supposed to have more acute audition than man; but this is with reference to hearing distant and minute sounds: man stands preeminent in his appreciation of the *expression* of sounds, and of their harmony. Some animals, however, are fascinated by harmonious sounds, and not attracted by others. Particular sounds, also, attract particular animals, as we see in bees.

The loudest voices do not affect in any sensible degree the new-born infant; after some time it appears to notice acute sounds, and hence the voice of females is much more attractive to it than that of men. It is very long before an infant can judge accurately of the intensity and duration of sound, particularly before it comprehends the meaning of different articulate sounds. Though the auditory apparatus becomes more perfect, in a physical sense, with age, it is, however, certain, that the hearing becomes more dull in the beginning of old age; and there are few old persons who are not more or less deaf. This circumstance seems to arise, on the one hand, from a diminution of the fluid of



Cotugno ; and on the other, from a diminution of sensibility in the acoustic nerve.

Disease modifies the hearing much. I cannot afford time to enter into all the causes of *deafness*, which are both numerous and interesting. Hearing is very acute in most febrile complaints, in which there is generally a singing or humming in the ears ; this arises from the irregular, and often excessive, distribution of blood to the auditory nerve, and may exist without any external sound whatever. In convalescence from, or in the decline of, fevers, on the contrary, more or less deafness prevails, and is a good sign. Many persons are deaf to certain sounds only, some hearing a weak, low, sound distinctly, and being utterly insensible to loud noises ; while others are alive to screams, and not to groans, and *vice versa*.

#### SENSE OF VISION.

Of all the senses this has been the most freely dilated upon. Popular lectures, without number, have been spoken and written ; treatises, without end, have appeared, that refer to this single, and, as is commonly believed, most important sensation of the economy. It is not my purpose to enter at any great length on it nevertheless ; first, because I have expatiated on the other senses until little space remains for this ; secondly, because it involves the laws of light, in themselves enough, as before mentioned, to occupy several lectures ; and

thirdly, because I am far from holding the opinion, that vision is so much preeminent before the other senses as to demand the study of them to give place to it. In fact, it is one of the most deceptive of the external sensations ; it by no means gives us the *precise* ideas of things that touch does, nor, in my notion, does it afford so *many* ideas as hearing does. Not long ago, in one of the learned societies of France, the question to be discussed was, whether the want of vision or hearing was the most deplorable as regards the curtailment of intellectual and moral notions ? when it was decided by a majority that the mind could least easily dispense with the sense of hearing. The *pros* and *cons* of this question cannot be now discussed ; but I may just ask, what would be the compass of our ideas were we confined to the vision of external animate and inanimate things, and debarred from the beautiful, the copious source of them, drawn from the voices of the intelligent beings around us ? Friendship and love, kindness and sympathy, may be expressed by the eyes of one individual, and recognised by those of another ; but how transcendently more convincing are the words, the tones, the expression of a voice, that whispers assurance of these feelings into the sentient ear !

For the above reasons, therefore, I shall avoid entering upon the mode in which light produces its effect upon the eye in the production of vision ; and, doing this, I of course dispense with the

minute anatomy of the eye, in itself a prolonged subject. It will then remain to advance some general anatomical and physiological facts that may be of popular interest in the question of this sensation.

The anatomical facts are, that the organ of vision is composed of a nervous expansion, called the retina, which is fundamental and essential ; of humours of various densities, and therefore of various refractive powers, forming the ball of the eye, and intended to arrange the rays of light so as to make them form a distinct image on the retina ; and lastly, of the accessory parts external to the ball, namely, the eyebrows, the eyelids, and certain muscles to move the ball in different directions. Moreover, across the anterior third of the ball is stretched a moveable, irritable, membrane, denominated the iris, (or *black* of the eye,) which is perforated in its centre, and which perforation is called the *pupil*. The iris being moveable, its movements diminish or increase the extent of the pupil—the dilatations admitting more rays of light to pass through, the contractions fewer. Now all the rays of light that proceed from a luminous body and fall upon the eyelids, the eyeball, or white of the eye, are reflected, and not transmitted. Those only are transmitted that impinge upon the dark centre of the ball ; and even of these rays, those which fall upon the iris are reflected or absorbed ; so that the only rays that tend to vision are those



that pass through the pupil, which, as I before said, regulates the quantity by its contraction or dilatation. Having passed the pupil, they are transmitted through the rest of the ball, and ultimately fall upon the retina, where the impression of the luminous body is made. This will serve for a brief sketch of the physiology of vision. I shall merely give short explanations of certain phenomena connected with the sense that are of sufficiently common occurrence, but little thought of by the laical part of the community.

*Single vision.* This is a curious fact when we consider, that the object viewed is impressed on two eyes. Gall, the phrenologist, thought that the eyes received the impression separately, but in an almost indivisible space of time. Experiments, however, go to shew that both eyes see the same object at the same time. Besides which, it is absolutely necessary that it should be so, for certain most important exertions of the function. In viewing minute objects, for instance, the perception of two objects would be confusing. Still it is hard to account for it, except on the ground of habit, which is forced upon us by the very confusion of double vision. Newly born infants always have double vision—in other words, squint; for they have not educated their sense of sight. One object, then, produces in reality two impressions, while the brain only perceives one. To produce this, the motions of the two eyes must be in unison.

If, after a disease, or from natural disability, the movements of the eyes are no longer uniform, we receive two impressions from the same object ; this constitutes *squinting*. By deranging the harmony of the two eyes, (by means of the muscles that move them,) we can at pleasure produce squinting, or two impressions from one body ; and as a converse proof that education causes one perception of one object from two impressions, it may be advanced, that children have really obtained a permanent squint by playing off that sort of vision in frequent joke.

There are, however, certain cases, in which it is more convenient to employ only one eye ; for instance, when it is necessary to understand accurately the direction of the light or the situation of any body relative to ourselves. Thus we shut one eye to take aim with a gun, or to place a number of bodies upon a level in a right line. Another case in which it is advantageous to employ only one eye is, when the two organs are unequal, either in refractive power or sensibility. This is the reason why we shut one eye when we employ a telescope, that with the instrument having undue advantage over the other, whose vision would therefore render the object viewed confused.

We judge of the *distance of objects* by the degree of that distance, and by the united action of the two eyes. When the object is near us, we can form a pretty correct notion ; but as the distance in-

creases, so are we constantly more or less deceived in forming our estimate ; this, moreover, is influenced by the size of the object, the intensity of the light that proceeds from it, and the presence of intermediate bodies. We always judge most correctly of objects that are on the same level with ourselves, as you may verify by looking at the same object on a level with yourselves and when you are placed in an elevated situation. As a proof of the two eyes being indispensable to form a correct notion of the distance of objects, it may be stated that persons who have by accident lost an eye, sometimes grope about for a length of time for objects within their reach. Previous knowledge and habit are more essential in aiding us to form a correct notion of the dimensions of bodies than the apparatus of vision. We are assisted by the size of the image formed on the retina, the intensity of light proceeding from the object, the distance at which we think it is placed, but, above all, by the habit of seeing such objects. When we see a body for the first time, and cannot appreciate its distance, we generally form an incorrect idea of its size ; as when we see a mountain for the first time, at a distance, it always appears less to us than it afterwards proves, as we approach it.

To judge correctly of the *motion of a body*, it is absolutely necessary that we ourselves should be at rest ; we then calculate its motion, by that of the image on the retina, and by the variations in the



size of this image, or in other words, by the change in the direction of the light which reaches the eye. When bodies pass very rapidly, particularly when they pass near us, as projectiles by gunpowder, we cannot perceive them ; but when they move at a distance from us, the light from them comes to the eye for a much longer space of time, because the field of view is greater, and we see them more easily. When they are at a great distance we judge of their motion by the variation of the size of their image ; and this being very small, we frequently find it almost impossible to estimate their motion. The same holds with regard to bodies that move very slowly, as is the case with the hand of a watch, where it results from the slowness of its own motion, or with the stars, where it arises from the slow motion of the image.

*Optical illusions.* From what has been said of the manner in which we judge of the distance, the size, and the motion of bodies, you will readily see that we are often deceived by sight. These deceptions constitute what are called Optical Illusions. Those which happen to us with regard to objects near us are the result sometimes of the reflection, at others of the refraction, of the light before it reaches the eye, and sometimes of the law established instinctively, that light proceeds always in straight lines. To these causes are referrible all the changes produced on light by glasses and mirrors ; if the

glass make the rays converge, the body will appear greater, if to diverge, the body will appear less. I have already mentioned, incidentally, several of these illusions, in speaking of the distance, size, and motions of bodies, and the laws which guide us in forming our judgment upon them.

When a bright object strikes the eye, while all around it is obscured, it appears much nearer than it really is; a fire at night produces this effect. The same is observed, if you look at objects of the same volume, unequally illuminated; the brightest will appear the nearest, whilst that which is really the nearest will seem the most distant, because it is more dull. Objects always appear small in proportion as they are distant; the trees in a long alley appear so much smaller and nearer together, in proportion as they are further removed from us. It is by observing these illusions, and the laws upon which they are founded, that the painter has been enabled to imitate them,—he, in certain cases, merely transferring to the canvass those optical errors into which we most habitually fall. The construction of optical instruments is also based on the same principles—some augmenting the intensity of the light proceeding from the objects viewed, others causing it to converge or diverge in order to increase or diminish their apparent volume.

*Inverted objects.* All objects, the rays from which

fall upon the retina, are there represented in an inverted position ; the rays from the lower portion of the object falling upon the upper part of the retina, those from the upper portion of the object on the lower part of the retina.

It is wonderful how much misplaced ingenuity was employed to explain this anomaly of seeing objects as they are when they are inverted on the nerve of sight. Bishop Berkeley's explanation of it is the best. He says, there is no occasion to touch an object in order to correct the error into which vision would seem to draw us ; for, as we refer all our sensations to ourselves, the right position of the object is only relative, and its inversion actually exists at the back of the eye-ball.

Vision varies in different ages. From infancy to manhood, the diminution of the quantity of the humours is very insensible, but it is very manifest in old age. An infant is at first attracted only by a very bright ; light it delights to look at the sun, the blazing fire, or a candle. It then becomes sensible to the day-light objects ; which are red, or of lively colours, are those that next strike and please it most. Gradually it appreciates the size and distance of objects, but it becomes perfect in these only by a real process of education.

Vision becomes impaired in old age, either from the diminution of the quantity of the humours, or the diminished sensibility of the optic nerve.



Of the diseased modifications of sight, there are two very common—viz., *short* and *longsightedness*. Shortsight occurs, when the ball of the eye is too full of humours, too convex anteriorly, or too great in depth. The rays of light then converge into a point, *before* they reach the retina, diverge again, and fall in a scattered manner upon it; the consequence is, imperfect vision. You remedy this by holding the object to the nose nearly, and using flattened or concave glasses. It is the bad sight of youth, when the fluids of the body are excessive.

In *longsight*, the eye is every way flattened, and the humours deficient. In this case, the rays of light are not yet collected before they reach the retina. The result is the same as in the last state, but the remedy is directly contrary. We hold the object to be viewed at a distance, and wear convex glasses. This is the bad sight of old age.

In some instances, the retina is so excessively sensitive, that the eye will scarcely support the slightest light. Persons so affected are called *nyctalopic*, or *night-seers*; they can only see objects by a feeble light, often only in comparative darkness. A contrary state, or that of deficient sensibility of the retina, is also known. In it, persons can only see by the broadest sunshine; they are then said to be *hemeralopic*, or *day-seers*. This is sufficiently common in the polar regions, where the strong reflection of light from the brilliant snows

exhausts the sensibility of the nerve, which thus comes to be unaffected by milder light. It is the beginning of another disease,—palsy of the optic nerve, known also by the name of *amaurosis*.

*Cataract* is the deposition of a milky, opaque, or brownish matter in the lens of the eye, preventing the passage of luminous rays to the retina, instead of the transparent solid matter naturally deposited. It is generally the result of bad digestion. I have already explained to you, in what *squinting* essentially consists. Any thing that irritates the brain, and prevents the healthy action of the will, may cause squinting; violent passions of the mind, teething, acid in the stomach, vermin in the bowels, water in the head, and other similar irritative causes produce it. In inflammation of the brain, the sight is excessively acute; in apoplectic fulness of the head, things are seen of a red hue, and flashes of light pass before the eye. In some kinds of indigestion, in vermination, and in typhus fever, black spots are seen by the patient. Persons in the last stages of typhus fever pick the bed-clothes, because they really imagine black spots, or animals, on the white sheets; in that disease it is a fatal symptom, betokening partial death of the optic nerve, the black spots being those portions of the optic nerve that receive no impression from light.

There are many other morbid anomalies of this

sense, the mere recital of which would be unsatisfactory without the explanation of them, while this again would require lengthened details that the time allows not of.

I have thus endeavoured to group together the leading physiological facts that bear upon the subject of our sensations, both internal and external. The plan pursued, as you may have perceived, has been—*first*, to give the notion of the generation of sensation, as it is now understood; *next*, to detail the peculiarities of those most essential and conservative feelings of our nature,—the *internal* sensations; and *lastly*, those of the external sensations, or the five senses, properly so called, which are merely accessory to our being, and have not, as the internal senses have, immediate, imminent, connexion with the maintenance of that being. I regret, however, that much interesting matter referring to the building up of the external on the internal senses has been unavoidably omitted, as also, some highly instructive comparisons between the organs and senses of man and the lower animals. These are points to which I may possibly return on some future occasion.

But it may be asked, of what practical use is the knowledge of the subjects herein discussed? In what manner does the physiology of the senses bear upon that useful information that tends to the intellectual, moral, or physical happiness of social



beings? Let me quote, in answer, the words of my friend Dr. Fletcher. After combating the frivolous and groundless objections urged against the study of physiology, from its being indelicate, &c., he proceeds to say—"But further, the study of physiology has claims upon our attention, as furnishing us with many general principles which may be rendered of practical advantage in the care of our health, and in preventing us from being imposed upon by the pernicious misrepresentations and malpractices of impudent and crafty charlatans; and upon whom is it, among ourselves, that the contemptible empirics of the present day live and fatten, while their terrified and poisoned victims quail under their grimaces, and totter to untimely graves under their drugs? 'It is,' as has been truly remarked by an able reviewer, 'to the deplorable ignorance, even of persons of education, with respect to the structure and functions of the human body, and everything which relates to health and disease, that we must ascribe the inability of such persons to distinguish between the rational practitioner and the quack.' " Thanks to the increasing diffusion of physiological knowledge, the age of farce is almost gone, the mist of delusion is fading away. The days of the necromancers, exorcists, and wizards—of the Powder of Sympathy, the Electuary of the three Devils, the Plaster of the hand of God, the Elixir of life, the immortal Catholicon, and numerous other infallible remedies of

former times have long been past. Let us hope, that those also of the Hohenloes, and St. John Longs, of the Balm of Gilead, the real Blessing to Mothers, and Morrison's Pills, are already numbered; and that one advantage of the progress of this science will be, that people in all time coming will be allowed to live without groundless apprehensions, and to die at last a natural and peaceful death.

THE END.





